

## PROMICE AIRBORNE SNAPSHOTS OF ICE FLOW VOLUME AND ICEBERG PRODUCTION IN 2007 TO 2011

By using airborne ice thickness measurements, the volume of ice flowing to the ocean is calculated.

In the PROMICE project two airborne surveys of the Greenland ice sheet's thickness were carried out, one in 2007 and one in 2011. The surveys followed a route tracing the perimeter of the ice sheet (Figure 1). In addition to advanced GPS equipment for high-precision



Figure 2. Twin Otter plane from Air Greenland used for the data collection campaigns in 2007 and 2011. Photo: Lars Stenseng, DTU Space.

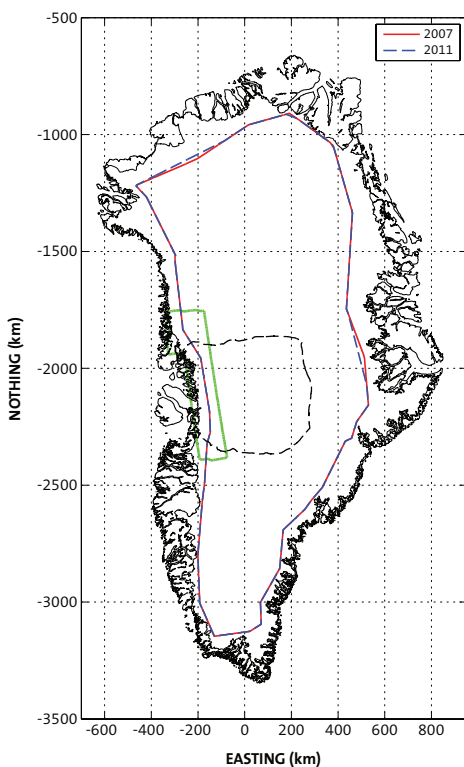


Figure 1. Location of the 2007 and 2011 flight lines. The green line indicates the area where the ice flow speed can be calculated from satellite images. The black dashed line shows the basin where we have calculated the dynamic mass loss.

position observations, the aircraft carried a radar for measuring the bed of the ice sheet and a laser for measuring the surface elevation. Together these two measurements provide ice thickness along the flight path. A single flight campaign takes approximately 10 days using the Dash-6 Twin Otter aircraft (Figure 2).

Using ice flow speed data from satellite measurements, thickness data allow us to calculate the amount of ice that flows out from the interior of the ice sheet. On its way to the coast some of the ice melts at the surface and runs off as melt water. What is left becomes icebergs that calve into the ocean from the large outlet glaciers, like Jakobs-havn Isbræ – the largest glacier in Greenland. The average ice mass flowing out from this catchment in 2007 and 2011 was approximately 70 Gigatonnes<sup>1</sup> per year, equivalent with nearly 10 tons per person on Earth, per

the two images it is possible to calculate how fast, and in which direction the ice is flowing. The amount of ice that is melted at the surface can be estimated from ground data and computer models simulating the climate over longer periods. The difference between these two numbers is then the ice mass that leaves the ice sheet as icebergs. When working with the mass balance of the Inland ice, it is typically divided into a number of independent basins. In a paper published in Geological Survey of Denmark and Greenland Bulletin later this year, we use this method to compute the volume of ice flowing out of the basin that is home to Jakobs-havn Isbræ – the largest glacier in Greenland. The average ice mass flowing out from this catchment in 2007 and 2011 was approximately 70 Gigatonnes<sup>1</sup> per year, equivalent with nearly 10 tons per person on Earth, per

year! Not all ice that flows into the ocean contributes to seal level rise, though. Just like some ice is melting along the margin of the ice sheet, some ice is also added by precipitation in the interior, thereby removing water from the oceans. Therefore, when discussing sea level rise, one must consider the total mass budget, where only the net deficit contributes to increasing sea levels.

How the dynamic mass loss is coupled to climate change is not well understood. Therefore it is valuable to investigate further.

Data from the airborne surveys are available by contacting [info@promice.dk](mailto:info@promice.dk)

<sup>1</sup> 1 Gigatonne = 1,000,000,000 tonnes, or one billion tonnes.

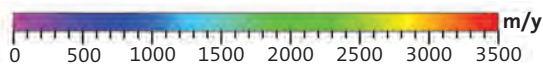
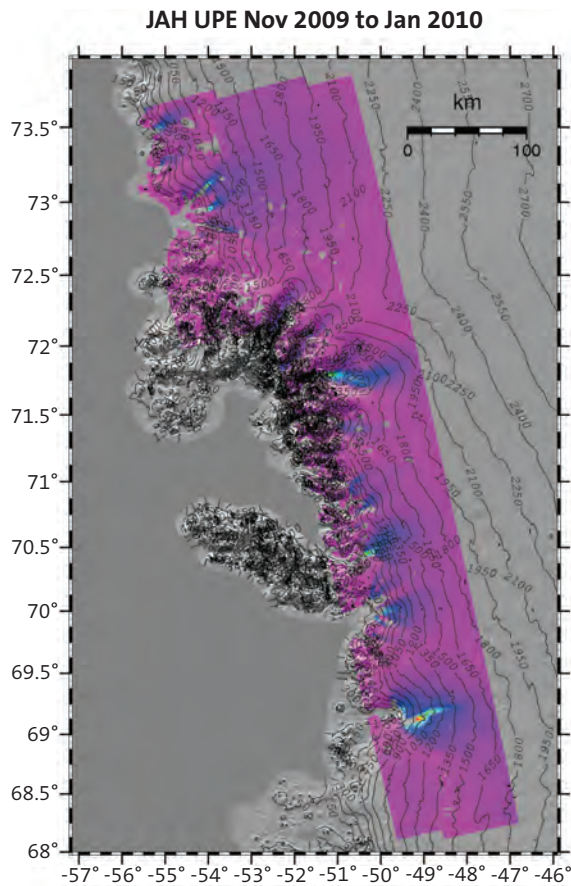


Figure 3. Ice flow speed and direction calculated from satellite images.



**LINKS**

- <http://www.promice.dk>
- <http://nsidc.org/greenland-today/>

**PROMICE**

PROMICE is financed by the Ministry of Climate, Energy and Building through the climate support programme DANCEA (Danish Cooperation for Environment in the Arctic), which is managed by the Danish Energy Agency.

• The purpose of PROMICE is to monitor the mass loss of the Greenland ice sheet, both the melting on the surface and the volume of icebergs discharged into the sea

- PROMICE is headed in Denmark by GEUS in cooperation with DTU Space and Asiaq in Greenland. Furthermore the programme collaborates with the Danish Meteorological Institute and foreign universities and authorities.
- Read more about PROMICE on [promice.org](http://promice.org), where you can find photos and videos, get direct access to measuring data from the ice sheet and the PROMICE outreach material. On the website you can also subscribe to our newsletter.
- Information can also be found on [parlorportal.org](http://parlorportal.org) a new website where Danish research institutions display the results of their monitoring of the Greenland ice sheet and the sea ice in the Arctic.

**Authors**

Morten Langer Andersen, forsker, GEUS.  
Signe Bech Andersen, seniorforsker, GEUS.

**Editor**

Signe Bech Andersen, senior researcher, GEUS.

**Layout**

Annabeth Andersen, GEUS.



**Geological Survey of Denmark and Greenland**  
Øster voldgade 10  
DK-1350 Copenhagen K  
Denmark



**Technical University of Denmark**  
Anker Engelunds Vej 1, 101A  
DK-2800 Kgs. Lyngby  
Denmark



**Asiaq**  
Qatserisut 8, P.O. Box 1003  
3900 Nuuk  
Greenland



**Ministry of Climate, Energy and Building**  
Stormgade 10-12  
DK-1470 Copenhagen K  
Denmark



**Danish Energy Agency**  
Amaliegade 44  
DK-1256 Copenhagen K  
Denmark